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Impact of Resisted Exercise on Chronic Obstructive Pulmonary Disease (COPD) in Elderly Patients in Alkharj, Saudi Arabia

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ABSTRACT

Some studies have evaluated the effect of resisted exercise on COPD in adult but there is limited data on the effectiveness of resistance exercise on COPD in elderly patients. The effect of three months resisted exercise training on pulmonary functions for COPD in elderly patients has been studied. The aim of this study was to investigate the influences of resisted exercise on COPD in elderly patients at Alkharj, Saudi Arabia. Forty obese elderly patients with moderate COPD with age of 60-70 years were selected from the patients living in Alkharj, KSA for this study. Their body mass index (BMI) ranged from 30 to $\geq$ 40 kg/m^2.They were randomly divided into two groups, each group consisted of 20 patients, group A received a program of resisted exercise(RE 3 times/week) with breathing exercise and group B received only breathing exercise without any program of resisted exercise. The pulmonary functions changes (FVC, FEV1, FEV1/FVC%, PEF, FEF25-75% and MVV) were measured at the beginning of the study and after twelve weeks. Showed that resisted exercise had greater improvement in FVC, FEV1, FEV1/FVC%, PEF, FEF25-75% and MVV were respectively (+0.1, +0.19, +4.2, +0.44, +0.09 and +3.8) when compared to the second group, little changes were respectively (+0.04, +0.04, +0.5, +0.45, +.03 and +1.2). It was concluded that a program of resisted exercise showed significant improvement in pulmonary functions in elderly patients with COPD in a short term (up to twelve weeks).

Key words: COPD, Resisted exercise, Pulmonary Function

INTRODUCTION

Many studies have evaluated the effect of the beneficial outcomes of resisted exercise on pulmonary functions in COPD in adult patients But there was limited studies clarify the effect of resisted exercise on elderly patients with COPD. The chronic obstructive pulmonary disease is considered as type of diseases which lead to morbidity and increase disability [1].

Chronic obstructive pulmonary disease (COPD) is called chronic obstructive airway disease defined as a type of respiratory disorder which occurred with a chronic limitation of air flow. It is diagnosed by some symptoms such as shortness and difficulty of breathing, coughing and sputum [2,3].

The most important and common cause of COPD is smoking, whether active or passive smoking. Also, there are other factors which lead to increase the rate of this disease such as air pollutions, heating fires that cause on long term of its exposure to lung tissue inflammation, narrowing of the lung airway and difficulty of breathing. So when measuring pulmonary function there will be poor results according to decreasing of air flow [4,5].

Treatment for COPD is most critical for those patients with poor pulmonary functions because they are at greater risk for progression of cardiopulmonary complications. The first step to decrease the rate of this disease is to decrease the exposure to environmental pollution, especially air pollution, including decrease smoking and improve the level of indoor and outdoor air. Management of COPD comprised of vaccination, stop smoking, respiratory rehabilitation and some medical treatment such as bronchodilators, steroids and oxygen therapy [5].

There were some acute worsening cases may need to increase the use of medications and placement in the hospital. Common symptoms of COPD included the difficulty of breathing, sputum and productive cough remain for prolonged periods and exacerbate over the time [2,3,4,5].

Also, Ability of persuading individuals to away from smoking is the best way to prevent COPD. Governments can decrease the smoking rate as the most common cause of COPD by encouraging the citizens to stop smoking and increasing programs of awareness about the risks of smoking. It is important to keep smoking bans in public places to reduce exposure to passive smoking, which affect the health of the elderly, children and all the living humans, plants and animals [6,7,8].

In some developed countries, there followed some new methods to improve quality of outdoor air and control air pollution through regulations that improve pulmonary functions and quality of breathing. If outdoor air is not controlled the COPD patients should stay indoors to decrease and control the symptoms of the disease [5,6].

No familiar cure is known for COPD treatment. On the other hand symptoms can be controlled and treated as it is responsive to medications. The main aim in COPD management is to control the risk factors and to prevent other associated complications. Smoking cessation and Oxygen therapy are only measures to decrease mortality rate of COPD. Only smoking cessation decreases the risk of mortality rate by 18% [4,5,7,9].

Pulmonary rehabilitation and respiratory care are a program of exercise to manage the disease with beneficial effects to the patients with respiratory disorders and then improve pulmonary function, activity daily living, quality of life, ability to do exercise, decrease the mortality and decrease disability. Pulmonary rehabilitation helps the patients with COPD to improve their self-sense to control their disease [10,11,12].

Resisted exercise is a type of exercise known as repetitive lifting weights by certain muscle groups. This type of exercise had a good and beneficial effect on rehabilitation of the aged patients with cardiac disease where it improves muscle force, enhance exercise capacity with directly improvement of venous return and ambulation [13,14]. Almost 60 years ago, recommendations of resisted exercise to improve muscle force hadn't changed since described by Delorme and Watkins. These recommendations are realizing few repetitions until fatigue, taking rest between exercises for recovery and increasing the resistance when muscle able to increase force production. These rules, which signed by the American college of sports medicine where it is confirmed that 8 to 12 repetitions 1 to 3 sets, 2 to 3 days weekly is the maximum repetition. Also, these repetitions should be through the range of motion without rest [15,16].

COPD may lead to functional lack, such as dyspnea and muscle weakness. Therapeutic exercise is very important to improve muscle strength, wellness and quality of life. Endurance exercise with high intensity is one of exercises which can enhance the quality of life and exercise performance, but some patients cannot do high intensity exercise because some symptoms occur such as muscle fatigue and dyspnea [17,18].

Two main basis for selecting resisted exercise in COPD. First one, the COPD patients is suffering from peripheral muscle weakness. So, resisted exercise of peripheral muscles will be helpful and well exhibited in COPD. Second basic, resisted exercise of small muscle groups may decrease the level of dyspnea [19,20].

Purpose of the Study

To investigate the effects of resisted exercise on COPD in elderly patients at Alkharj, Saudi Arabia.

MATERIALS AND METHODS

Patients

Forty obese elderly patients with moderate COPD aged 60-70 years were selected from the patients living in Alkharj, Saudi Arabia for this study. Their body mass index ranged from 30 to $\geq$ 40 kg/m^2. The forty patients were divided into two groups; each group comprised of twenty patients. Group A (study group) received a program of resisted exercise (RE 3 times/week) with breathing exercise and Group B (control group) received breathing exercise only. Any patient had cardiovascular disorders, severe life limiting illness (cancer, renal failure), orthopedic limitation, weight loss medication and endocrine disorders were excluded from the study.

Instrumentation

Weight and Height scale (Healthy scale 200 kg) used to measure the weight, height and BMI of each participant, Bicycle Ergometer (FIT306,China) was used for warming up exercise, Small free weights (0.5, 1 or 3 kg) and Digital spirometer (CONTEC:SP10,China) to measure pulmonary functions (FVC, FEV1, FEV1/FVC%, PEF, FEF25-75% and MVV).

Procedure

A- Evaluation

After selection of the patients An informed consent was taken from all patients that participated in the study, Before starting the study all patients were informed about the nature, benefits and procedure of the study, The sample was randomly assigned into two groups equal in number, 20 for each group; Study group (A) received a program of resisted exercise (RE 3 times/week) with breathing exercise and control group (B) received breathing exercise only. All chest radiographs were elucidated regularly in the radiology department and observed by a chest physician to assess any lung disorders. The pulmonary function tests were measured by spirometer at the beginning of the study included forced vital capacity (FVC), forced expiratory volume in one second (FEV1), FEV1/FVC%, peak expiratory flow (PEF), forced expiratory flow 25-75% (FEF25-75%)and maximal voluntary ventilation (MVV).

B) Training

The steps of exercise training were explained to each patient. Group (A) received the program of resisted exercise (RE 3 times/week) with traditional breathing exercises for twelve weeks, according to the following parameters; the mode of exercise was resisted exercises. Intensity of exercise was, according to the one repetition maximum 1RM (I.e. Maximum weight lifted in one full range of motion) typically to cover the many muscle groups it comprised of 8 to 12 trains, which includes the chest, shoulders, arms, back, abdomen, thighs, and lower legs. The resisted training was moderate (30% to 40% of 1RM) to the upper limb and (50% to 60% of 1 RM) for lower limb [21]. Duration; the first five to ten minutes of each session were dedicated to warming up exercise on a bicycle ergometer and the same for the cooling down phase. There were a twenty minutes of resisted exercise (30-40min). Frequency was three times per week for 12 weeks. Group (B) received only traditional breathing exercise set was 3 times/day 3 times weekly for twelve months. At the end of the program (after 12 weeks), other pulmonary functions were recorded and all measures were obtained and the pre- and post- measures for the two groups were compared.

Statistical Analysis

Descriptive statistics was done in the form of mean and standard deviation. Inferential statistics evaluated changes in Pulmonary functions (FVC, FEV1, FEV1/FVC%, PEF, FEF25-75% and MVV) using unpaired *t*-test between the two groups and paired *t*-test was used to measure changes within group, analysis was done using SPSS version 18 with significance $p \leq 0.0001$ and relatives change percentage was calculated according to:

Relatives changes percentage = $\frac{\text{post}-\text{pre}}{\text{pre}} \times 100$

RESULTS

Demographic and clinical Characteristics of the Patients:

There was no significant difference between both groups in their ages, BMI and pulmonary functions respectively with p-value ≤ 0.0001. Table 1 and figure 1. But there were statistically significant differences between the two groups at the end of the study. Figure 2.

Table 1: Demographic and clinical characteristics of patients in both groups (A&B)

Items		Age (yr.)	BMI (Kg/m^2)
Group (A)	Mean ± SD	65.6±3.22	34.75±3.54
	Maximum	70.00	41.00
	Minimum	60.00	30.00
Group (B)	Mean ± SD	65.9±2.71	34.95±3.58
	Maximum	70.00	42.00
	Minimum	61.00	30.00
t-value		0.3188	0.1771
P-value		0.7517	0.8598
Significance ($P \leq 0.0001$)		NS	NS

**Yr: Years Kg/m^2: Kilogram/meter square BMI: Body Mass Index*
SD: Standard Deviation NS: No significant P: Probability

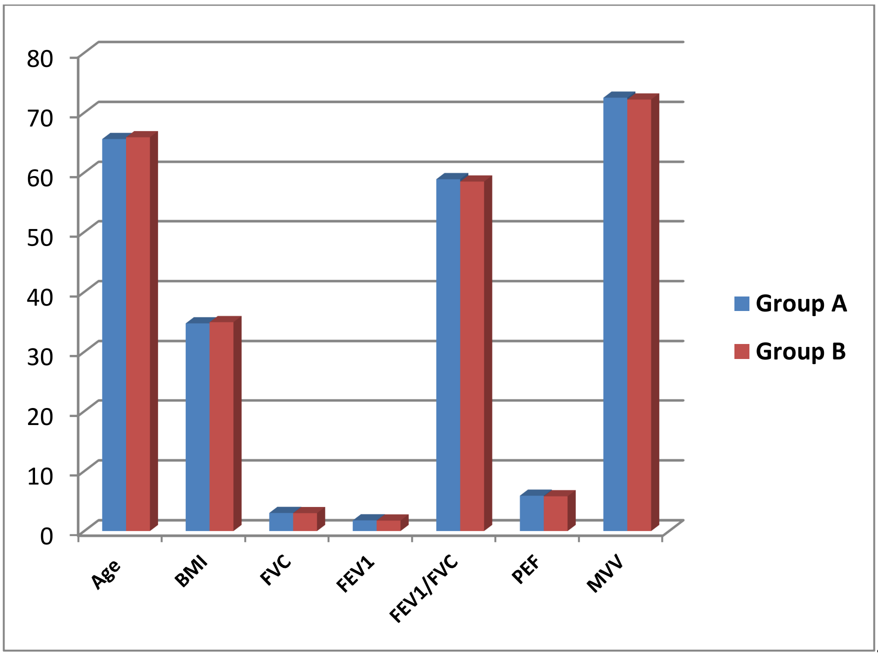

Figure 1:Demographic and clinical characteristics of patients in both groups at the beginning of the program

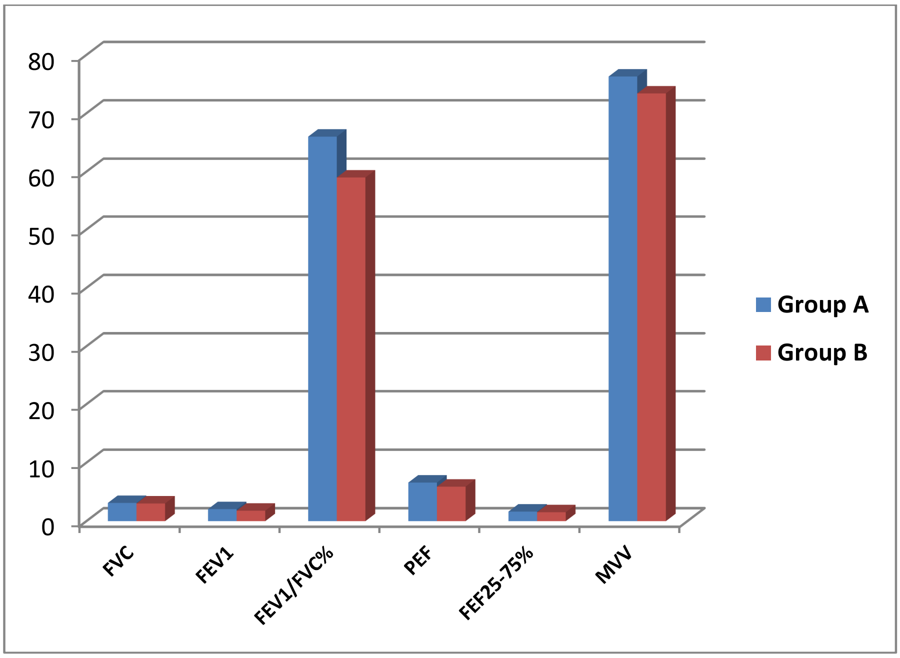

Figure 2: Statistical analysis of mean differences in pulmonary functions between group (A) and group (B) pre- and post-the program

The results of this study showed that forced vital capacity (FVC)was statistically significant increase in both groups. The percentage of change of FVC for group (A) was 3.31%, whereas, in group (B) was 1.33%. Compared with recipients of breathing exercise only (group B), recipients of a program of resisted exercise combined with breathing exercises (group A) had the greatest increase in FVC (+0.1 I(btps); P≤0.0001 vs. +0.04 I(btps); P≤0.0001). Table 2 and figure 2.

Table 2: Statistical analysis of mean differences in FVC between group (A) and group (B) pre- and post-the program

Items	Pre-	Post-	t-value	P-value	% of changes	Sig.
Group A Mean ± SD	3.02±0.0506	3.12±0.0249	8.443	0.0001	+3.31%	**S**
Group B Mean ± SD	2.99 ±0.0279	3.03±0.0280	6.2128	0.0001	+1.33%	**S**
t-value	2.328	10.7417				
P-value	0.0257	0.0001				
Sig. (P≤0.0001)	**NS**	**S**				

** SD: Standard Deviation* *S: Significant*
P: Probability *NS: No significant*

The results of this study showed that forced expiratory volume at one second (FEV1)was a statistically significant increase in group A but it was a no significant increase in group B. The percentage of change of FEV1 for group (A) was 10.67%, whereas, in group (B) was 2.28%. Compared with recipients of breathing exercise only (group B), recipients of a program of resisted exercise combined with breathing exercises (group A) had the greatest increase in FEV1(+0.19 I(btps); P≤0.0001 vs. +0.04 I(btps); P=0.0006). Table 3 and figure 2.

Table 3: Statistical analysis of mean differences in FEV1 between group (A) and group (B) pre- and post-the program

Items	Pre-	Post-	t-value	P-value	% of changes	Sig.
Group A Mean ± SD	1.78±0.0215	1.97±0.0391	19.3759	0.0001	+10.67%	**S**
Group B Mean ± SD	1.75±0.0304	1.79±0.0318	4.0870	0.0006	+2.28%	**NS**
t-value	3.6032	23.9584				
P-value	0.0009	0.0001				
Sig. (P≤0.0001)	**NS**	**S**				

** SD: Standard Deviation* *S: Significant*
P: Probability *NS: No significant*

The results of this study showed that (FEV1/FVC%)was a statistically significant increase in group A but it was a no significant increase in group B. The percentage of change of FEV1/FVC% for group (A) was 7.13%, whereas, in group (B) was 0.08%. Compared with recipients of breathing exercise only (group B), recipients of a program of resisted exercise combined with breathing exercises (group A) had the greatest increase in the FEV1/FVC% (+4.2; P≤0.0001 vs. +0.5; P=0.0017). Table 4 and figure 2.

Table 4: Statistical analysis of mean differences in FEV1/FVC% between group (A) and group (B) pre- and post-the program

Items	Pre-	Post-	t-value	P-value	% of changes	Sig.
Group A Mean ± SD	58.9±0.236	63.1±0.921	22.8361	0.0001	+7.13%	**S**
Group B Mean ± SD	58.5±0.405	59.0±0.294	5.6302	0.0017	+0.08%	**NS**
t-value	3.8163	32.3804				
P-value	0.0005	0.0001				
Sig. (P≤0.0001)	**NS**	**S**				

** SD: Standard Deviation* *S: Significant*
P: Probability *NS: No significant*

Table 5: Statistical analysis of mean differences for PEF between group (A) and group (B) pre- and post-the program

Items	Pre-	Post-	t-value	P-value	% of changes	Sig.
Group A Mean ± SD	5.885±0.0339	6.33±0.0884	23.3543	0.0001	+7.56%	**S**
Group B Mean ± SD	5.86±0.0405	5.90±0.0294	5.6302	0.0001	+0.68%	**S**
t-value	3.3870	33.6032				
P-value	0.0017	0.0001				
Sig. (P≤0.0001)	**NS**	**S**				

** SD: Standard Deviation* *S: Significant*
P: Probability *NS: No significant*

The results of this study showed that peak expiratory flow (PEF)was a statistically significant increase in both groups. The percentage of change of PEF for group (A) was 7.56%, whereas, in group (B) was 0.68%. Compared with recipients of breathing exercise only (group B), recipients of a program of resisted exercise combined with breathing exercises (group A) had the greatest increase in PEF (+0.44 I/sec; P≤0.0001 vs. +0.045 I/sec; P=0.0001). Table 5 and figure 2.

The results of this study showed that forced expiratory flow 25-75% (FEF25-75%)was a statistically significant increase in group A but it was a no significant increase in group B. The percentage of change of FEF25-75% for group (A) was 5.96%, whereas, in group (B) was 2.0%. Compared with recipients of breathing exercise only (group B), recipients of a program of resisted exercise combined with breathing exercises (group A) had the greatest increase in FEF25-75% (+0.09 I/sec; P≤0.0001 vs. +0.03 I/sec; P=0.0024). Table 6 and figure 2.

Table 6: Statistical analysis of mean differences in FEF25-75% between group (A) and group (B) pre- and post-the program

Items	Pre-	Post-	t-value	P-value	% of changes	Sig.
Group A Mean ± SD	1.51±0.0195	1.60±0.0287	10.4874	0.0001	+5.96%	**S**
Group B Mean ± SD	1.50±0.0205	1.53±0.0260	3.5074	0.0024	+2.0%	**NS**
t-value	1.5806	12.7030				
P-value	0.1222	0.0001				
Sig. (P≤0.0001)	**NS**	**S**				

** SD: Standard Deviation* *S: Significant*
P: Probability *NS: No significant*

The results of this study showed that maximum voluntary ventilation (MVV)was a statistically significant increase in both groups. The percentage of change of MVV for group (A) was 5.24%, whereas, in group (B) was 1.66%. Compared with recipients of breathing exercise only (group B), recipients of a program of resisted exercise combined with breathing exercises (group A) had the greatest increase in MVV (+3.8 I/min; P≤0.0001 vs. +1.2 I/min; P≤0.0001). Table 7 and figure 2.

Table 7: Statistical analysis of mean differences for MVV between group (A) and group (B) pre- and post-the program

Items	Pre-	Post-	t-value	P-value	% of changes	Sig.
Group A Mean ± SD	72.5±0.348	76.3±0.474	7.234	0.0001	+5.24%	**S**
Group B Mean ± SD	72.2±0.253	73.4±0.278	13.397	0.0006	+1.66%	**S**
t-value	3.1183	23.6014				
P-value	0.0035	0.0001				
Sig. (P≤0.0001)	**NS**	**S**				

** SD: Standard Deviation* *S: Significant*
P: Probability *NS: No significant*

DISCUSSION

This study was attended to study the effect of resisted exercise on elderly patients with COPD (RE 3 times/week for 12 weeks) on pulmonary functions. With the hypothesis that there is no significant effect of Resisted exercise on elderly patients with COPD.

The comparison between the two different groups (A&B) revealed statistically significant improvement in FVC, FEV1, FEV1/FVC%, PEF, FEF25-75% and MVV in group (A) resisted exercise combined with breathing exercises P≤0.0001. On the other hand, a group (B) breathing exercise only without resisted exercise it was statistically significant in FVC, PEF and MVV with p≤0.0001 but non-significant in FEV1, FEV1/FVC% and FEF25-75% with (P≥0.0001).

The pulmonary functions at group (A) had the greatest improvement from pre to post-program (after 12 weeks); FVC +3.31%, FEV1 +10.67%, FEV1/FVC% +07.13%, PEF +7.56%, FEF25-75% +5.96% and MVV +5.24% when compared with the results in group (B); FVC +1.33%, FEV1 +2.28%, FEV1/FVC% +0.08%, PEF +0.68%, FEF25-75% +2.0% and MVV +1.66%.

Khosravi et al. [22] confirmed this study result where they studied the combination of endurance exercise with resisted exercise on pulmonary function on healthy subjects their results clarified that resisted exercise has beneficial impact on FVC, FEF25-75%, PEF and MVV.

In agreement with this study results Farid et al. [23]proved that there was significant improvement in FVC, FEV1, PEF, FEF25-75% and MVV but not similar result in non-significant improvement in FEV1/FVC when studied 8 weeks of exercise in asthmatic subjects thrice weekly sessions.

Similar results are found in Tartibian et al. [24] which showed that there was significant improvement in FVC, MVV, FEF25-75%, FEV/FVC% after grappling exercise three times weekly for twelve months.

In a randomized controlled study by Shaw and Brown [25]approved similar results that The COPD patients that followed the aerobic exercise (45 min with 60%HR_{max}) and resisted exercise (8 trains, 60%1RM, 3 sets with 15 rep.) presented a significant improvement of FVC, FEV1, PEF and FEF25-75%.

Also, Noury et al. [26] demonstrated that after performing running exercise, there was significant improvement in FVC, FEV1, FEV1/FVC%, PEF and FEF25-75% when they studied the effect of high intensity running exercise on pulmonary function in children.

In addition, Wright et al. [27] assessed twelve weeks impact of maximum strength exercise on chronic obstructive pulmonary disease found that there was a significant increasing in FEV1 5.3%.

These data demonstrated that resistance exercise provided benefits for the management for COPD, and the long-term impact of this now requires evaluation.

Noury et al., 2005 explained that the improvement of pulmonary functions may be caused by increasing of muscle contractility [28] or strengthening of respiratory muscles, especially expiratory muscles [29,30] and by improving of lung compliance or the balance of the airway resistance [29,31].

Many studies interpreted that the respiratory muscle's capacity may be increased with suitable stimulus which directed to increase the muscle work load, so respiratory muscles exercise through many exercise modalities aimed to accelerate cellular alterations in the exercised muscles [32].

On top of that, exercise improves pulmonary function as a result of respiratory muscles strengthening, improving airway diameter and reducing airway resistance [24,33]. Also, exercise, increase circulation and vasodilatation and lead to adrenaline and cortisol secretion. Adrenaline increases vasodilatation of pulmonary vessels which improve airway quality and decrease resistance elevating FVC and FEV1 [34,35]cortisol increases bronchodilatation which improve production of lung surfactant [36].

It was concluded that resisted exercise (RE 3 times/week for 12 weeks) improves pulmonary functions in elderly patients with COPD. Physical activity improves pulmonary functions through positive changes in muscle strength which achieve a balance of airway resistance and improving airway flow through vasodilatation of pulmonary vessels and bronchodilatation. Resistance exercises effectively improve respiratory muscle performance and may be beneficial for improving airway flow and respiration. This study approved that resisted exercise should be recommended in COPD treatment to improve peripheral muscle strength and small muscle groups may decrease the level of dyspnea.

CONCLUSION

It was concluded that a program of resisted exercise proved significant improvement in pulmonary functions in elderly patients with COPD in a short term (up to twelve weeks).

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